International Journal of Psychosocial Rehabilitation, Vol. 24, Issue 09, 2020
ISSN: 1475-7192

The Moderating Effect of Performance Management on Operational Control, Technical Control and Telecommunications Systems Performance in the Public Safety Sector of Oman

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Abstract

Many of today's mission-critical networks in Oman public safety sector face a two-fold challenge. Firstly, modernization of communications infrastructure is required because the present-day requirements for real-time data, sophisticated control as well as monitoring functions surpass the capacity of the existing narrowband networks. Secondly, sustaining real-time communication security is an existing issue, due to the fact that private commercial providers are contracted to handle public safety information coordination, giving them access to sensitive information as well as increased interference. In the Omani context, a change in strategy is required, thus, creating a need for further research to investigate this in a holistic framework. However, this is lacking in the literature and needs to be addressed. In this paper, Technical control and Operational control are independent variables. Performance management is the moderator variable and Telecommunications systems performance is the dependent variable. A quantitative study which employed a self-administered questionnaire for a field survey was carried out on a stratified population of telecommunication users in the Omani public safety sector. Out of a total number of 429 questionnaires administered to the target research population 384 questionnaires were returned and 379 were useable for statistical analysis, which were analyzed using SPSS. After fulfilling assumptions of outlier screening, normality of data distribution and multicollinearity, the quantitative data were subjected to multiple regression analysis, in order to test five research hypothesis. The findings reveal that the direct effect of operational control and performance management on telecommunications system performance was positive and statistically significant, but the direct effect of technical control on telecommunications system performance was not significant. Moreover, it could be concluded that performance management positively moderates the relationship between technical control and telecommunications system performance. Also, that performance management positively moderates the relationship between operational control and telecommunications system performance

Keywords: Public safety, telecommunications, systems performance, performance management, technical control, operational control

1. Introduction

Public Safety refers to the welfare and protection of the general public which is usually expressed as a governmental responsibility. Globally, every government has a responsibility to ensure the safety and security of the general public, however, in Oman, public safety agencies still depend on the existing commercial telecom service providers for voice call and data services thus making it increasingly difficult to function in the face of the increased threat of terrorism, including physical and cyber warfare. More so, the public safety agencies in Oman currently depend on the telecommunication emergency plan of public service providers in case of disaster recovery and security threats thus limiting coordination between security agencies (Valeri, 2015).

The importance of adequate information infrastructure to enable effective and up-to-date communication has been witnessed in recent events, for instance, recent major socio-political revolts in the Middle East, terrorist attacks, as well as geographical turbulence in the form of natural disasters and epidemics. These are even worsened by

mismanagement of crisis events due largely to untimely information sharing and inappropriate information and communications technology infrastructure (Santana, 2008; Safa et al., 2015). In the Omani context, a change in strategy is required because it has been argued that public safety agencies in Oman are limited in their ability to effectively coordinate timely information exchange between public safety departments via a national telecommunications backbone to deliver unified voice and high-speed data to the public safety technology users (Naqvi and Al-Shihi, 2009). Hence, investment in national backbone infrastructure is required to deliver unified voice and high-speed broadband access for each public safety agencies.

Moreover, the global risks report issued by the World Economic Forum, stated that organizational performance in relation to the top issues faced by organizations in the current era are largely related to performance management issues during operational crisis (Risks, 2015). The present study embodies a re-examination of the relationship that exists between telecommunications technology predictors (technical control and operational control) and telecommunications system performance with the intervention of performance management acting as a moderator in the public safety sector of Oman. However, it must be noted that even though studies that have been carried out on performance of information and communications technology infrastructure, it is lacking in the context of the public safety sector which in itself presents unique characteristics. Also, prior research hasn't been well grounded, as well as their findings being inconclusive. Moreover, studies have failed to consider the moderating role of performance management in this relationship, hence creating a gap in knowledge. The findings from the current study, will thus enrich the extant debate in the literature.

Furthermore, there is a challenge in the present system of information and communications infrastructure in the public safety sector in the Sultanate of Oman, and the volatility in this sector exposes public safety personnel who are users of the public safety information infrastructure to threats from a wide range of risks leading to security challenges. It is thus matter of concern, and this needs to be addressed.

In addition, numerous meta-analytic studies have suggested that performance management systems not only respond to the increasing expectations of an organization's technology requirements, but also enhance their overall performance (Ballesteros-Orozco, 2017). However, some authors (Kagaari, Munene, and Mpeera Ntayi, 2010; Kim and Brymer, 2011) believe that this assertion is largely dependent on the context, and the industries involved; as a result, a considerable proportion of variance is left unexplained especially in highly sensitive sectors such as public safety. Hence, questions still exist regarding the extent in which performance management moderates this relationship in the public safety sector. These details limit the knowledge available to stakeholders, thus creating a knowledge gap on how the overall framework incorporating telecommunications technology predictors, performance management and telecommunications system performance affect the overall performance of public safety communications technology users in Oman. Thus, the public safety agencies ought to have an independent and high resilient telecommunication network which allows emergency responders across the country to communicate with other agencies in a real time. This objective of this paper is to examine the moderating effect of performance management on technical control and operational control as independent variables, and public safety telecommunications systems performance, as dependent variable.

2. Conceptual Framework and Hypotheses

The conceptual framework (Fig 1) is intended to test five (5) research hypotheses (Table 1). The hypotheses are: the direct effects of Technical control (TCN), Operational control (OCN), on Telecommunications Systems Performance (TSP) which refer to hypotheses H_1 and H_2. And two hypotheses related to the moderation effect of Performance management (PMT) on the relationship between Technical control (TCN) and Operational control (OCN), as independent variables on Telecommunications Systems Performance (TSP) as dependent variable (i.e., H_3 and H_4).

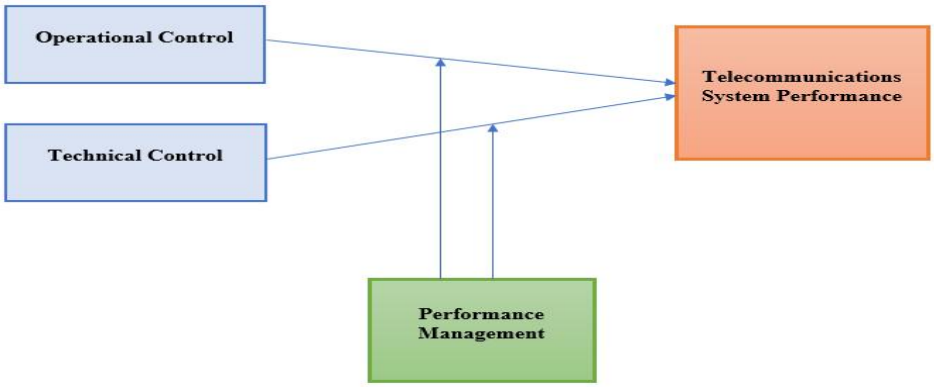

Figure 1: Conceptual Framework

2.1 Research Hypotheses

The codes and description of the research hypotheses are represented in Table 1.

Table 1: Research Hypotheses (Codes and Descriptions)

Code	Description	Path
H_1	Technical control (TCN) has a positive effect on telecommunications systems performance (TSP)	TCN → TSP
H_2	Operational control (TCN) has a positive effect on telecommunications systems performance (TSP)	OCN → TSP
H_3	Performance management (PMT) has a positive effect on telecommunications systems performance	PMT → TSP
H_4	Performance management (PMT) moderates the relationship between Technical control (TCN) and telecommunications systems performance (TSP)	PMT*TCN→TSP
H_5	Performance management (PMT) moderates the relationship between Operational control (OCN) and telecommunications systems performance (TSP)	PMT*OCN→TSP

3. Methodology

This causal study utilized cross sectional quantitative data relying on deductive reasoning. A quantitative y strategy was employed using a self-administered structured questionnaire to collect quantitative data in a field survey directly from the target research population made up of telecommunications users in the public safety sector in Oman.

3.1 Instrument development

A self-administered questionnaire was used as the measurement instrument for the field survey. The questionnaire was constructed from previously established measurement scales (Table 2) anchored on a 5-point Likert scale (strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree). However, due to contextual differences in studies which can present significant variances, a content validity testing and a pilot study to examine the reliability of the measurement scales over purposively recruited samples was conducted before administering the final survey (Aigbogun, Ghazali & Razali, 2018).

The content validity conducted by subjecting the survey questionnaire to a panel of 6 experts. The experts comprised of two academic experts in the field of innovative technology and four industry experts vast in the subject matter of information and communications technology and have many years of experience in the public safety sector. The comments from the expert validators as well as their suggestions were utilized to refine and modify the questionnaire items. Typographical errors, long sentences, double meanings, and words that might be difficult to comprehend would be removed or replaced. This helped in the reduction of any form of bias and/or uncertainty as well as ensuring the maintenance of an appreciable quality standard and validity of the research instrument. After the content validity, the questionnaire was translated from English to Arabic using a back translation method suggested by Dillman (2000). Afterwards, a pilot study was carried out aid in determining the viability of the projected data

analysis procedures, and to examine the reliability as well as enhance the internal validity of the survey questionnaire items.

The pilot study which involved a small-scale evaluation (N=39), was carried out before the main field survey. The questionnaire items were refined according to the comments from the pilot respondents, also, in the test for internal consistency reliability using Cronbach alpha, all the measurement scales were above the recommended threshold (0.7) and were considered reliable (Nunnally, 1978).

Table 2: Instrument measures and sources

Variables	No of items	Sources
Technical control	5	Ballesteros-Orozco, (2017)
Operational control	4	Kagaari, Munene, and Mpeera Ntayi (2010)
Performance management	6	Kagaari, Munene, and Mpeera Ntayi (2010)
Telecommunications systems performance	7	Rivard (2000)

3.2 Sampling

The target research population is characterized by means of the context of the study which focusses on the users of telecommunications technology in the public safety sector in the Sultanate of Oman. The sampling frame for this research survey was drawn from the official departmental classification of public safety. A sample size was determined (Krejcie & Morgan 1970) from the total population (N=7946) of telecommunication users among the public safety personnel in Oman. A stratified sampling design was used, and In carrying out the stratified sampling, the relevant categories/divisions/groups/strata in public safety sector of the Sultanate of Oman were first identified will first be identified, and then the telecommunication users were then outlined in the same proportion in the which they exist in the total population. Consequently, samples were then drawn from each category/group/stratum according to the required sample size from the stratum.

3.3 Data Analysis

A total of 384 questionnaires were returned (a response rate of 89.5%) after the main survey and after proper data screening and cleaning procedures 379 usable questionnaires were subjected to descriptive and inferential statistical tests. Assumptions of multiple regression analysis was fulfilled and the research hypotheses were tested using multiple regression analysis.

4. Analysis and Findings

4.1 Socio-Demographic Characteristics of Survey Respondents

The present study makes use of categorical data in describing the demographic characteristics of the survey respondents. From the analysis of the profile of the survey participants who are the users of telecommunications technology in the public safety sector in Oman, the following were observed. Out of number of participants (N=379) surveyed, there were more male users (88.7%) than female users (11.3%). In addition, the largest number of users that took part in the questionnaire field survey are in the age group of 31-40 years (56.5%) while the least are in the age groups less than 20 years (0.5%) and over 60 years (0.5%). In terms of educational level, it is observed that 21.7% of the respondents have bachelor's degree or its equivalent and 3.7% possess a Master's degree as their highest educational qualification. The least of the survey participants have a doctoral degree as their highest academic qualification (0.8%), while the majority of the survey participants possess other form of qualifications aside those listed (71.4%). Moreover, with regard to the respondent's number of years working in their current position in the public safety sector in Oman, a majority of the respondents have worked 12 years and above (46.7% while the least of them have worked less than 1 year (4.0%).

When asked about their perception of the importance of ICT innovation to their job roles in the public safety department of Oman, they were given the opportunity to select their choices based on the following options: 1- Very

important (it's one of the top priorities and part of the culture to create better services); 2 – Important (it's used as an important instrument to improve our jobs); 3 medium Priority (it's of average importance and used to enable competitiveness); 4- Low Priority (it's of little importance and sometimes driven by short-term opportunistic situations); 5- Not a Priority (it's NOT important to our job roles). From the responses, a majority of the respondents view ICT innovation in public safety as one of the top priorities and part of the culture to create better services (76.0%).

4.2 Assumptions of Multiple Regression

To fulfill the assumptions of multiple regression, the following were carried out: screening for outliers, tests normality of data distribution, and testing for multiple collinearity.

Screening for outliers was carried out by examining the scatter plot. On examination of the scatter plot, a roughly rectangular distribution was observed. Testing for normality of data distribution was carried out using Shapiro Wilk's test as well as Skewness and Kurtosis test. The Shapiro Wilks test reveals that all of the variables reported p-values greater than 0.05, so the null hypothesis that the data come from a normally distributed population is accepted. The result for multicollinearity test reveals that the Variance Inflation Factor values are well below the threshold value of 10. Therefore, we can infer that there was no multicolinearity amongst the independent variables (Cohen and Cohen, 1983).

4.3 Correlation Analysis

To explore the relationship among the variables involved, correlation test was carried out using Pearson's correlation matrix. The inter-correlations coefficients (r) were calculated by the means of Pearson's Product Moment. The relationships between Technical control, Operational control, and Performance management, were investigated against telecommunication systems performance. Table 3 shows the summary of the results which indicates that there are positive correlations between Technical control, Operational control, and Performance management, as predictor variables and telecommunication systems performance as the output/dependent variable which are significant at the 0.05 level.

Table 3: Summary of Pearson's Correlation Matrix

		Technical control	Operational control	Performance management	Telecommunication systems performance
Technical control	Pearson's rho	1.000			
	Sig (p) value				
	N	379			
Operational control	Pearson's rho	0.355*	1.000		
	Sig (p) value	0.000			
	N	379	379		
Performance management	Pearson's rho	0.433*	0.399*	1.000	
	Sig (p) value	0.000	0.004		
	N	379	379	379	
Telecommunication systems performance	Pearson's rho	0.403*	0.311*	0.507*	1.000
	Sig (p) value	0.000	0.001	0.000	
	N	379	379	379	379

**Correlation is significant at the 0.05 level*

4.4 Multiple Regression Analysis

The importance of the multiple regression analysis in the present research is its significance as a predictive test in examining the differential effect of performance management (the moderating variable) on the relationship between the independent variables (operational control and technical control) and the dependent variable (telecommunications system performance). In order to test the moderator (performance management), there was a

need to center and compute the moderator variable (performance management) and the dependent variable (secured telecommunications system performance) and then have a product of multiplied centered variables and that would give the interaction effect. To compute the centered variables for each response, the mean of each variable (moderator and dependent variable) was subtracted from the respective variable. The resulting variables were then coded as Cpmt and Ctsp respectively for performance management and secured telecommunications performance. To calculate the interaction effect, the product of the centered variables (Cpmt and Ctsp) were calculated (Cpmt*Ctsp) hence bringing about the desired interaction for this regression model which is coded as 'CpmtCtsp'.

The Table 4 and 5 are the outputs from the multiple regression test

Table 4. Model summary of multiple regression analysis

Model	R	R^2	Adjusted R Square	R Square Change
1	0.665	0.442	0.433	0.442
2	0.685	0.469	0.459	0.027

Table 5: Coefficient table for multiple regression analysis

		Beta	Sig
Model 1	Technical control	0.078	0.157
	Operational control	0.254	0.000
	Performance management	0.272	0.002
Model 2	Technical control	0.189	0.031
	Operational control	0.118	0.000
	Performance management	0.223	0.000
	CpmtCtsp	0.205	0.000

Dependent Variable: Telecommunication systems performance *(*p value <0.05)*

From the multiple regression output (Table 4), the value of R^2 is 0.442 (model 1) meaning that technical control, operational control, and performance management explains 44.2% of the variability in telecommunications system performance. However, it is observed that the effect of operational control and technical control when the interaction term (CpmtCtsp) was added as a moderator (model 2), accounted for an additional 27.0% (R^2 Change) of variance in telecommunications systems performance, which was significant (Sig F Change = 0.000) at the p = 0.05 level. Furthermore, from the output of the regression coefficients in the Table 5, the following results are observed;

Hypotheses One (H_1): Technical control is not a significant predictor of telecommunications systems performance ($\beta_1 = 0.078$, $p > 0.05$). This means that for every unit increase in the score of technical control, a non-significant 0.078 increase in the score of secured telecommunications systems performance is predicted, holding all other variables constant. Thus, the alternative hypothesis (H_1) is rejected, hence supporting the null hypotheses hypothesis *H_1: Technical control does not have a positive effect on telecommunications system performance*

Hypotheses Two (H_2): Operational control is a significant predictor of telecommunications systems performance ($\beta_2 = 0.254$, $p < 0.05$). This means that for every unit increase in the score of operational control, a 0.254 significant increase in the score of secured telecommunications systems performance is predicted, holding all other variables constant. Thus, the null hypothesis (H_0) is rejected, hence supporting the alternative hypothesis *H_2: Operational control has a positive effect on telecommunications system performance*

Hypotheses Three (H_3): Performance management is a significant predictor of telecommunications systems performance ($\beta_3 = 0.272$, $p < 0.05$). This means that for every unit increase in the score of performance management, a 0.272 significant increase in the score of telecommunications systems performance is predicted, holding all other variables constant. Thus, the null hypothesis (H_0) is rejected, hence supporting the alternative

hypothesis *H_3: Performance management has a positive effect on telecommunications system performance*

Hypotheses Four (H_4): Looking at the p-value (model 1) of the regression test for technical control, it can be observed that technical control was not a significant predictor of telecommunications system performance (0.157). But when the interaction term (CpmtCtsp) was entered into the model (model 2) as a moderator, technical control becomes a significant predictor of telecommunications system performance (0.031). According to Baron and Kenny (1986), and Kim et al. (2001), we can then infer that performance management moderates the relationship. Thus, the null hypothesis (H_0) is rejected, hence supporting the alternative hypothesis *H_4: Performance management moderates the relationship between technical control and telecommunications system performance*

Hypotheses Five (H_5): Looking at the p-value (model 1) of the regression test for operational control, it can be observed that operational control was a significant predictor of telecommunications system performance (0.000). And when the interaction term (CpmtCtsp) was entered into the model (model 2) as a moderator, operational control still remains significant (0.000). According to Baron and Kenny, (1986), and Kim et al. (2001), we can then conclude and infer that performance management moderates the relationship. Thus, the null hypothesis (H_0) is rejected, hence supporting the alternative hypothesis *H_5: Performance management moderates the relationship between operational control and telecommunications system performance*

5. Conclusion

The findings from this study reveal that the direct effect of operational control and performance management on telecommunications system performance was positive and statistically significant. But the direct effect of technical control on telecommunications system performance was not significant. Moreover, it could be concluded that performance management positively moderates the relationship between technical control and telecommunications system performance. Also, that performance management positively moderates the relationship between operational control and telecommunications system performance

This has vital theoretical and practical implications to both researchers, public safety officers, policy makers and regulators. Theoretically, the findings of this research demonstrate that performance management intervenes in public safety communication security by helping to improve the maintenance and sustenance of process communication integration between public safety personnel especially preparing it for emergency situations. In addition, the contingency theory suggests that there is no universally applicable system of performance management but that the choice of appropriate control techniques will depend upon the circumstances surrounding a specific organization. Hence, a central contingent variable is the strategy and objectives that an organization decides to pursue. Not only are these objectives likely to heavily influence the choice of performance measures to be used i.e. the desired outcomes but they also must act as the criteria against which the contingent choices that have been made can be evaluated. This also helps policy makers to strengthen policies that would enforce investment in necessary capabilities in public safety telecommunications infrastructure.

This research has some limitations which includes the following: It should be noted that the research was carried out within a specific sector (public safety), and in one country (Oman), however, replications in other contexts would increase confidence of the research findings. This provides other researchers with an opportunity to carry out a comparative analysis with the results of the present research. Furthermore, in collecting primary data, the present research relied on cross sectional data as well as subjective responses only. It is suggested that future researchers supplement this with a longitudinal study as well as some form of objective data as this might provide more robust information.

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